An Education Grounded in Biology: Interdisciplinary and Ethical Considerations

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ABSTRACT—Work in the new area of Mind, Brain, and Education (MBE) raises epistemological and ethical issues. With respect to epistemology, the norms of the component disciplines must be honored and the resulting amalgam must be more than a mere sum of the parts. With respect to ethics, the roles of scientist, educator, and practitioner each raise ethical dilemmas and the MBE worker must be cognizant of each set of dilemmas and the possible strains among them. Only if both of these spheres are confronted can good work be achieved in MBE.

All of us who are interested in placing education on a more scientific basis are excited by the prospect of new insights from the biological sciences, particularly from studies of the human brain and the human genome. Still, for many of us, this excitement is tinged with reservations. On the one hand, we are wary of premature and unrealistic expectations about the extent to which education can actually be enhanced through findings from the biological sciences; on the other, we worry that injudicious interventions may exert effects that are at once powerful, unpredictable, and perhaps even harmful.

I have spent 20 years carrying out neuropsychological research, 20 years working in the American school system, and nearly a decade helping to fashion a program on Mind, Brain, and Education (MBE) at the Harvard Graduate School of Education. In these capacities, I have had the chance to wear a number of hats: scholarly hats in psychology and biological sciences; a practitioner hat as a teacher who works with educators; and, on occasion, the hat of the policy maker (Gardner, 2007a). These involvements have given me the opportunity to think about the relationships among these enterprises—the extent to which they are independent, synergistic, or potentially at odds with one another.

In this article, I step back from the fray and reflect on two lines of collaborative research. With Veronica Boix-Mansilla and colleagues, I have been investigating the nature of disciplinary and interdisciplinary work, the latter exemplified in attempts to combine cognitive science, neuroscience, and education (Boix-Mansilla & Gardner, 1997). In a second endeavor, with Mihaly Csikszentmihaly, William Damon, and colleagues, I have been studying work in various professions, both traditional and emerging (Gardner, 2007b; Gardner, Csikszentmihalyi, & Damon, 2002; Gardner & Shulman, 2005). In what follows, I draw on our initial findings in both bodies of research as they pertain to a biological basis for education. Although these two strands of research have an independent existence, I conclude with a consideration of how they might contribute synergistically to the pursuit of good work in the area of MBE.

HOW BEST TO CHARACTERIZE EDUCATION: A FIELD OF MULTIPLE PERSPECTIVES

Disciplines are human inventions—they differ from one another in the time period over which they have existed and the extent to which they are accepted by the relevant communities. No one would dispute that history and mathematics are disciplines, and few would question that biochemistry, history of science, or behavioral genetics, once mistrusted newcomers, have taken their place comfortably within the disciplinary landscape. Whether falling under the umbrella of natural science, humanities, or social science, individual disciplines have their canons of practice, standards of scholarship, and associated paraphernalia, ranging from catalogues to conferences to textbooks. Although the study of education might loosely be considered a discipline, it does not actually

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conform to the features I have just itemized. Rather, it is a set of loosely coupled perspectives.

Nor does the practice of education qualify unambiguously as a profession. Following common practice in sociology, I define a profession as a group of individuals who have gone through extensive training, ascribe to a central set of values (e.g., the Hippocratic oath) have received a license, and are afforded status and flexibility in return for making complex judgments under conditions of uncertainty. In the world of today, law, medicine, and engineering have attained the status of professions. Although collegiate teaching might be regarded as a profession, precollegiate teaching has only marginal professional status, especially in the United States. I would characterize precollegiate education as an aspiring profession. And in many ways, teaching itself is better thought of as a craft and ensemble of skills, rather than as a discipline or profession.

Where education differs from most professions is in the contentiousness that surrounds so many of its activities. Medicine, law, accounting, engineering, and architecture all involve value judgments; however, the core values of these professions are not particularly controversial, except perhaps among those who are intimately involved in its practice or critique. In contrast, education is driven by fundamental questions of value on which nearly all citizens have strong and often inconsistent opinions. For example, consider the rival goals of preparation for citizenship; preparation for the workplace; mastery of the great traditions of the past; training for the unknown future; a focus on academics, the arts, or athletics. One can find defenders and critics in every hamlet. As I have sometimes quipped, how in the United States, could we ever come up with an educational agenda that would please Jesse Helms, Jesse Jackson, and Jesse Ventura?

It is important to stress that education is a contentious and value-laden profession because outsiders often fail to recognize this fact. For example, almost everyone involved in the scientific study of languages argues that we should teach foreign languages to young children. In principle, it is difficult to object to this assertion. And yet, description does not entail prescription. Like it or not, as a preparation for one's future life, it is much more important to teach foreign languages in Switzerland or Hungary than it is to teach it in Spain or the United States. Moreover, even if languages are deemed important, any addition to the curriculum necessarily entails a loss. Are foreign languages so important that they should replace time in reading and writing in one's native language, training in handling social conflict, or exposure to the arts and athletics? Those who deem education to be value-free are either naïve or duplicitous.

If education is not a discipline, and is, additionally, an odd kind of profession, how best to describe those individuals who are training to be educators? (I deliberately use the term "educator" rather than teacher because I want to cover a broader terrain.) I see education as *a terrain for taking multiple perspectives.* Indeed, educators ought to be able to think about educational issues from a number of points of view. Perhaps at most, they will have attained disciplinary expertise in one or two standard disciplines. However, they ought to have enough of a familiarity with other relevant disciplines so that they can at least participate meaningfully when important issues are being addressed.

An example. Let us say that a large and heterogeneous school system is considering the introduction of a new mathematics program, from K-12. This program comes highly recommended because of its reputed success in teaching mathematics in Singapore, but the program does not have much of a track record in our very different society. Ideally, the leaders of the school system would want to pick the brains of a number of disciplinary experts: in mathematics; in the teaching of mathematics; and in the demography of the community. In addition, we would probably include scholars of cultural variation, who could speak to the differences between the American and Singapore contexts and economists who could talk about the resources needed and the potential benefits and costs of a major change in teaching, training, and evaluation.

Of course, such a battery of experts is a pipe dream; no school district in the United States could or would assemble them (whether Singapore might field such a team is an intriguing question—it is a very different kind of society that places a much greater value than ours on the optimal identification and deployment of talent). As I construe it, an educator should at least understand the input from these various disciplines, synthesize it, and make a recommendation that could be defended to critical experts and justified to an often skeptical public of students, teachers, principals, and parents. In the future, I hope that educators will have the kind of training that would allow them, in my terms, at least to don these disciplinary "hats."

INTERDISCIPLINARY WORK IN MBE

While educators should strive to master a "multiple-perspective" approach, scholars in the new area will need to achieve a more ambitious goal. To do original research in MBE, a person must become a genuine interdisciplinarian, able to deal substantively with the relevant areas of biology, psychology, and education. I say "relevant" because studies of human motivation will require a different kind of expertise than research on the learning of mathematics or the teaching of poetry. However, at least a journeyman's knowledge of biology, psychology, and education will be necessary.

Everyone talks about interdisciplinary work. Many claim to be doing it and to be training their students for eventual participation. Alas, all too often these claims are empty. One would laugh at a person who claims to be bilingual if she did not speak more than one language. Hence, too, the claim to be interdisciplinary is vacuous unless a person can specify the disciplines covered by this label and demonstrate requisite expertise in each. You can now see why I have chosen to describe the work of most educators as "entailing multiple perspectives" rather than as "interdisciplinary"—the former label is easier to redeem than the latter.

Our studies of interdisciplinarity suggest at least three motivators for interdisciplinary work, each applying to to an identifiable sphere:

1. *Problem-based phenomena.* Scholars who are trying to understand a puzzling phenomenon often find themselves drawn to interdisciplinary work. A good example here would be the condition of developmental dyslexia. It is generally recognized that 5–10% of young persons—probably more males than females—have unexpected difficulties in learning to decode and understand written language. Knowledge of several sorts is relevant in the understanding and treatment of dyslexia: knowledge of language (particularly written language), expertise in psychological testing, understanding of behavioral genetics, ability to carry out and interpret studies of brain functioning, and——most important—skill in special education. Problem-based issues are most likely to arise and be investigated in medical or clinical settings.
2. *Hypothesized underlying abstract factors.* From time to time, it appears that widely disparate phenomena can all be modeled and explained because each reflects the same underlying factor. Most often, the factor is a mathematical structure. Classically, the psychologist Piaget (1983) explained a range of understandings in terms of a single underlying mental operation; and the psychologist Hull (1966) sought to lay out the basic laws of learning in a fashion patterned after Newtonian laws of physics.

   In recent years, such models from mathematics have been introduced to make sense of a range of phenomena. Complexity theory has been proposed as an explanation for entities ranging from changes in weather to fluctuations of the stock market to the evolution of natural species. In the area of learning, scholars look to neural networks and to nonlinear dynamic systems as explicating a gamut of learning phenomena. Typically, the motive for this interdisciplinary work is basic scholarly inquiry.
3. *Contextual accounts.* Yet another stimulus for interdisciplinary work emanates from the desire to explain *why* certain events occur, *when* they occur, and *in the way* that they occur. Contextual explanations typically draw on historical, sociological, and cultural factors. For example, one might ask why a civil rights revolution, a feminist revolution, and a sexual revolution occurred in many countries in the 1960 s. Using an example close to home, one might ask why an interest in brain-based education has exploded in the last decade, particularly in the United States and Great Britain. Such questions cannot be approached in the absence of insights from the social sciences and the humanities. Questions of this type are of interest to scholars, journalists, and the general public.

We propose three criteria for the evaluation of such interdisciplinary work (cf. Boix-Mansilla & Gardner, 2003; Boix-Mansilla, Feller, & Gardner, 2006):

To begin with, we ask that the work honor the assumptions, procedures, and strictures of each individual discipline. In the case of dyslexia, inputs from genetics, neural imaging, psychometrics, and pedagogy must each meet the standards of experts in the respective domains.

Second, genuine interdisciplinary work must provide insights that go beyond the contributions of the constituent disciplines. To borrow a common phrase, the whole must be greater than the sum of its parts. Thus, an understanding of a person with developmental dyslexia should not consist solely of one quotation or finding each from a queue of the aforementioned experts. Rather, through a skillful combination of insights from the constituent disciplines, one ought to be able to reach better grounded conclusions about how best to treat a particular configuration of symptoms or—more concretely—how to educate the child in question.

Finally, interdisciplinary work must be perpetually self-reflective. The comfort and routine that accompanies work in a standard paradigm is a sign that one is no longer in interdisciplinary territory—perhaps because the ones hybrid field has now consolidated, perhaps because one was not carrying out genuine interdisciplinary work in the first place. The complete interdisciplinarian or, more commonly, the interdisciplinary team should exhibit a self-critical nature, humility, tentativeness, and a willingness to go back to the drawing board to learn more or to learn again.

At the Harvard Graduate School of Education, Kurt Fischer, David Rose, a number of gifted teaching fellows, and I have attempted to realize this vision. We have fashioned a full-year course called "Cognitive Development, Education and the Brain." The course seeks to develop "multiple-perspective skills" in 1-year masters' students; it also provides a foundation for eventual interdisciplinary work by our doctoral students. The challenge for students is to learn to wear different hats as they confront problems of the sort described above: how to treat students diagnosed as dyslexic, or how to select the appropriate mathematics curriculum (Blake & Gardner, 2007).

The constituent spheres in our course are brain study, particularly neuropsychological testing and results of neuroimaging; psychology, particularly cognitive-developmental psychology; basic familiarity with behavioral genetics; and education, particularly at the precollegiate level. Students view prerecorded lectures, interact with scholars from the several constituent disciplines, read widely, and carry out exercises and experiments that give them a feeling for how each of these spheres operates. Our overarching metaphor is an MBE atelier, in which teachers and students of varying degrees of expertise work together to co-construct a new interdisciplinary or multiple-perspective area.

After some experimentation, the faculty arrived at four "throughlines" that are examined in turn. We spend several weeks each on the cognition and teaching of number; the cognition and teaching of literacy; the role of emotions and motivation in learning; and the construction of concepts in early life and their reformulation, as needed, in formal education. For each topic, we consider the relevant theoretical issues; review the prevalent methods and representative findings; observe young persons learning in these spheres; and consider specimen curricular and pedagogical interventions.

Needless to say, most students (not to say the teachers) are initially overwhelmed by the demands of the course and the need to don varied hats. Amazingly, however, by the conclusion of the course 8 months later, most students have become comfortable in approaching problems from the varying perspectives of the neuroscientist, the psychologist, and the precollegiate educator. And although our own evaluations are still in progress, we are confident that our students are able to perform their understandings in a variety of ways that we could not even have imagined a decade ago, and that the students did not exhibit before the course.

THE ETHICAL DIMENSION

Carrying out multiple-perspective or interdisciplinary work is demanding enough; it might seem that the introduction of a new straw—the ethical dimension—would break the proverbial camel's back. In truth, ethical issues arise only incidentally in our course. However, as stated at the outset, vexed ethical issues are already beginning to crop up across the horizon of biological science and education; those of us who are pioneering in the field have a responsibility not to sweep these issues under the rug (Gardner, 2007b).

As it happens, in addition to the study of interdisciplinarity, I have been engaged for the last 15 years in an ambitious collaborative study of professional ethics, known as the GoodWork® Project (see goodworkproject.org and references cited there). My colleagues and I have been studying work that is at once excellent in technical quality, personally engaging, and ethically responsible. The ensemble of candidate good workers includes the publisher Katharine Graham, the baseball player Jackie Robinson, the medical scientist Jonas Salk, just to mention a few. The question that animates our work is how individuals who seek to carry out good work succeed or fail at times when conditions are changing very quickly, market forces are very powerful, and few if any counterforces moderate the pressures of markets (see Fischman, Solomon, Greenspan, & Gardner, 2004; Gardner, 2007b; Gardner, Csikszentmihaly, & Damon, 2002).

Why should ethics be a concern for those who work at the intersection of MBE? I regard it as a near certainty that within a few years, parents (and children) will come to school with neuron-imaging records and/or gene chips that contain potentially important information about a child's intellectual strengths, weaknesses, and potential. At the same time, there promises to be a slew of products on the market that claim to improve memory, attention, and perhaps even quite specific cognitive skills such as calculation or learning a second language. Consumers will expect advice and recommendations from educators. And if educators are unable or unwilling to interpret these biological indices, education will soon become a medical subspecialty, for good or ill.

Our research documents that good work is most likely to come about when all of the individuals with a stake in a profession want the same thing from that work. Among nine professions that we have examined in our project, the science of genetics at the end of the 20th century emerged in the United States as a singularly well-aligned domain. That is because, roughly speaking, everyone wanted the same thing from the geneticists: long life and good health. Thus, virtually the only constraints on geneticists were those that they imposed on themselves. In contrast, other professions such as journalism, accounting, law, and precollegiate education emerge as much less well aligned. Different constituencies have quite diverse goals for practitioners who, in turn, often feel torn in various directions.

When a profession is not well aligned, practitioners are tempted or pressured to don more than one hat. And when professionals attempt to wear more than one hat at a time, troubles can arise. We noted this phenomenon when speaking to genetics researchers who were also heavily involved in for-profit corporations. A not uncommon pattern is the geneticist who carries out government-supported research at the university in the morning, and then travels to another place of work later each day in a company that may well be carrying out research that is secret. Knowing when one is following the open precepts of the scientist and when one has donned the garb of a profit-bent entrepreneur is not easy. Practitioners are wont to confuse hats—particularly when it is in their self-interest to do so. The same problems arise in dramatic form when a journalist becomes a publisher—and must decide how much allegiance to pay to the disinterested practice of journalism, and how much to cater to the whims of the audience, the concerns of touchy advertisers, and the pressures from avaricious investors.

In the case we are considering here, the major constituent professions are the scientist and the educator. Scientists describe the core mission of science as understanding the world, modeling it accurately, reporting studies faithfully, being truthful above all—and no question or issue should be off limits. In contrast, as confirmed by the interviews in our research, the core mission of the educator is to assume responsibility for the mental—and perhaps also the physical and the spiritual—life of the young person. The educator needs to determine the most important knowledge of the past, the knowledge that is most vital for the future, and the kind of citizen that is desired—all value-laden issues, as I noted at the beginning of this article.

Both professions in question have an ethical core, but the ethics are quite different. The scientist's obligations are primarily to the calling of science and—by extension—to the rest of the scientific community. The educator's obligations are primarily to young persons and their families and—by extension—to the rest of society. Sometimes these missions can commingle comfortably, but there is no guarantee that will be the case. Indeed, it is easy to think of questions that the scientist would like to be able to answer but that would be unethical to pursue; and there are as well many questions that would interest educators, but that scientists would not know how to approach or would think were not of significant scientific interest.

This tension existed even when the natural sciences had not reached the point at which educational questions seemed pertinent. However, when findings from genetics or brain study hold promise of being relevant to education, the pace quickens. The scientist may want to apply his findings to education but not be aware of the value-laden nature of the enterprise, or he may see his findings applied in ways of which he does not approve (this happened to me after I had introduced the theory of multiple intelligences—Gardner 1983, 1999, 2006). The educator may want to help his students, but not have a full understanding of the implications of the scientific work, or he may observe a pharmacological intervention that is ineffective or even harmful and yet feel powerless to oppose it.

TOWARD A RECONCILIATION

I have described two problem spaces that can be considered separately: the nature of multiple-perspective or interdisciplinary work, such as that involved in the newly emerging field of MBE; and the effort to carry out good work in and across the professions, including science, clinical practice, and education. In conclusion, drawing on our findings about the features of quality interdisciplinary work, I suggest how it might be possible to bridge the two problem spaces—more colloquially, how to wear a number of hats in ways that are intellectually honest and ethically sound.

Members of the newly designated area need a working knowledge of three spheres: biological science (spanning brain study and genetics), psychology (including learning, cognition, and motivation), and education (teaching, curriculum, and assessment). To do high quality "good work" that combines these spheres in a productive way, such designated individuals should follow the following three precepts of interdisciplinary work in an ethical way:

1. Observe the disciplinary norms of the constituent disciplines (e.g., brain science, psychology) and the core values of the relevant professions (science, education).
2. Combine these constituents so that the whole is greater than the sum of its parts. Insights about brain science and psychology must yield an understanding that neither could achieve on its own; the scientist and the educator must arrive at a professional amalgam that neither profession could represent on its own.
3. Temper all decisions with a generous proportion of reflection, tentativeness, and humility. As the broader population looks to the new field of MBE for insights and recommendations, those of us who belong to that field should resist the temptation to play God or to invoke more knowledge and authority than we actually have. We must acknowledge that ethical issues pervade this new terrain and cannot be marginalized or postponed. Within the foreseeable future, at least some of us will be called on to make consequential decisions about which course of action to recommend and which to avoid. Knowledge is vital; but in the tension between knowledge and humility, humility should be more heavily weighed.

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